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Resources for Teaching Research and Statistics in Psychology

Title of Resource	Hand Calculation: t-test for Dependent Means(Drugs & Learning)
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Brief Description:	This activity can be used as practice after students have learned how to hand calculate a t-test for dependent means.
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Instructors:

Instructors should assign this problem to students as in-class practice or homework after students have learned how to calculate a t-test for dependent means and test for significance. The activity leads students through determining the type of statistical analysis to use, the hypotheses, calculating the t-ratio and effect size (if appropriate), making a decision about the null hypothesis and summarizing the results. An answer key is included.

Practice: t-test

A researcher is interested in the effects of two new drugs, Drug A and Drug B, on learning. She has a group of 5 people take Drug A and then work on a learning task. One month later, the same 5 people take Drug B and then work on the same learning task as before. The number of errors made on the learning task after taking each drug is recorded below. **Using an alpha of .01**, test for a difference between the groups.

Participant	Drug A	Drug B
1	7	3
2	5	1
3	4	4
4	8	2
5	6	5

1. Which type of test will you use? Support your answer.

2. State H_0 and H_1.

3. Is this a one-tailed or two tailed test? Why?

4. What are the df associated with this test?

5. What is/are the critical value(s) one should use to test the researcher's hypothesis at the .05 level?

6. Calculate the *t*-ratio. Be sure to show all of your work.

7. Make a decision about the null hypothesis and support your decision.

8. Calculate the effect size, if applicable, and what effect size tells us.

9. Give a summary statement about the results. Think about the decision on the null, the group means and effect size (when applicable).

ANSWERS

Practice: t-test

A researcher is interested in the effects of two new drugs, Drug A and Drug B, on learning. She has a group of 5 people take Drug A and then work on a learning task. One month later, the same 5 people take Drug B and then work on the same learning task as before. The number of errors made on the learning task after taking each drug is recorded below. **Using an alpha of .01**, test for a difference between the groups.

Participant	Drug A	Drug B
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3	4	4
4	8	2
5	6	5

1. Which type of test will you use? Support your answer.

   A *t*-test for dependent means should be used. This is a repeated measures design and therefore the means for each group are dependent. (The results of Drug A on learning are matched to the results of Drug B for each participant.)

2. State H_0 and H_1.

   Null: There is no difference between errors made in the learning task when taking Drug A compared to Drug B.
   Alternative: There is a difference between errors made in the learning task when taking Drug A compared to Drug B.

3. Is this a one-tailed or two tailed test? Why?

   The alternative hypothesis is non-directional therefore a two-tail test should be conducted.

4. What are the df associated with this test?

   $df = N - 1 \rightarrow 5 - 1 = 4$

5. What is/are the critical value(s) one should use to test the researcher's hypothesis?

   4.604

6. Calculate the *t*-ratio. Be sure to show all of your work.

X_1	X_2	D	$D - M_D$	$(D - M_D)^2$
7	3	4	4-3 = 1	1
5	1	4	4-3= 1	1
4	4	0	0-3= -3	9
8	2	6	6-3 = 3	9
6	5	1	1-3 = 2	4
$\sum X_1 = 30$	$\sum X_2 = 15$	$\sum D = 15$		$\sum(D - M_D)^2 = 24$
$N_1 = 5$	$N_2 = 5$	$M_D = 3.00$		
$M_1 = 6.00$	$M_2 = 3.00$			

$$S_D^2 = \frac{\sum (D - \mathrm{M}_D)^2}{\mathrm{N} - 1} \qquad S_D^2 = \frac{24}{5-1} \qquad S_D^2 = \frac{24}{4} \qquad S_D^2 = 6.00$$

$$t = \frac{M_D}{\sqrt{\left(\frac{1}{\mathrm{N}}\right) S_D^2}} \qquad t = \frac{3}{\sqrt{\left(\frac{1}{5}\right) 6}} \qquad t = \frac{3}{\sqrt{1.2}} \qquad t = \frac{3}{1.10} \qquad \boxed{t = 2.73}$$

7. Make a decision about the null hypothesis and support your decision.

One should fail to reject the null hypothesis as he calculated *t*-ratio is not equal to or higher than the critical value of *t*. The group means are the same.

8. Calculate the effect size, if applicable, and what effect size tells us.

The effect size should not be calculated because there is not a significant difference between group means.

9. Give a summary statement about the results. Think about the decision on the null, the group means and effect size (when applicable).

There is no significant difference between Drug A and Drug B on the number of errors made on the learning task. The mean number of errors made while taking Drug A (M = 6.00) is the same as the mean number of errors made when taking Drug B (M = 3.00).